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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/717,122	11/19/2003	Larry Zhao	2000.106900	7303
23720	7590	07/12/2006	EXAMINER	
WILLIAMS, MORGAN & AMERSON 10333 RICHMOND, SUITE 1100 HOUSTON, TX 77042			GHYKA, ALEXANDER G	
			ART UNIT	PAPER NUMBER
			2812	

DATE MAILED: 07/12/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

10/717,122

Applicant(s)

ZHAO ET AL.

Examiner

Alexander G. Ghya

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --  
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☐ Responsive to communication(s) filed on \_\_\_\_.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 39-56 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 39-56 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_ are subject to restriction and/or election requirement.

ALEXANDER GHYKA  
PRIMARY EXAMINER

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*Alex Ghya*

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 19 November 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some \* c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)  
Paper No(s)/Mail Date \_\_\_\_.
- 4) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date \_\_\_\_.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_.

### DETAILED ACTION

The RCE of 5/8/2006 has been entered. Claims 1-38 are cancelled. Claims 39-56 are now under consideration. The following new rejection is made in view of Applicants' amendment.

#### ***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

**Claims 39-56 are rejected under 35 U.S.C. 103(a) as being unpatentable over Rajagopalan (US 6,656,840) in view of Lam et al (US 6,548,418).**

The present claims generally providing a structure comprising an exposed copper surface; and performing a single deposition process to form a single silicon

nitride layer on said exposed copper surface, said single silicon nitride layer having a first surface that interfaces with the exposed copper surface and a second surface that is opposite the first surface, wherein the parameters of the deposition process are adjusted such that a concentration of silicon in said single silicon nitride layer gradually increases from the first surface to the second surface.

Rajagolan et al disclose forming a copper structure on a surface; forming a first layer which comprises a silicon nitride layer; and forming a second silicon nitride layer wherein the the atomic ratio of nitrogen to silicon in the first layer is greater than the atomic ratio of nitrogen to silicon in the second layer, or in other words the second layer is silicon rich. See column 14, lines 30-40. Rajagolan et al disclose the nitride layers are formed using plasma enhanced chemical vapor without interrupting vacuum as required by present Claim 40, 46 and 55. See Example, column 13-14 and column 14, lines 45-50. Moreover, Rajagolan et al discloses using silane and nitrogen without ammonia to form the first layer, and silane and nitrogen without ammonia to form the second nitride layer, wherein the molar ratio of nitrogen to silane in the first layer is greater than the nitrogen to silane in the second layer. See the Example on columns 13-14 and column 14, lines 53-60. Ammonia can be used in forming the second layer. See column 11, lines 20-45. Furthermore, the plasma is not interrupted as required by claims 44, 45 and 52. See columns 13-14, the Example.

Rajagolan et al differs from the present claims in that it does not disclose a that the concentration of silicon in the silicon nitride layer gradually increases from the first surface to the second surface.

Lam et al also disclose silicon nitride barrier layers and disclose the formation of a silicon nitride layer which has a gradient throughout, "a structure which at the surface of the substrate has excellent barrier properties to positive mobile ion penetration and then gradually increases the silicon to nitrogen ratio so that the outer surface has high etch selectivity". See column 4, lines 55-65.

It would have been obvious for one of ordinary skill in the art, at the time of the invention, to use a silicon nitride layer which has a gradient throughout in the process of Rajagolan et al, for its known benefit of providing barrier properties on one surface and high etch selectivity on the other surface as disclosed by Lam et al. The use of a known material, silicon nitride with a gradient throughout, for its known purpose, as a barrier layer, would have been obvious to one of ordinary skill in the art.

Claims 47 and 53 further require a deposition process for forming a nitride layer comprising a silane flow rate of approximately 120-170 sccm and a nitrogen flow rate of approximately 220-330 sccm; and transitioning to a deposition process comprising a silane flow rate of approximately 200-250 sccm and a nitrogen flow rate of approximately 30-80 sccm.

It would have been obvious to one of ordinary skill in the art, at the time of the invention, to arrive at the flow rates as required by the present claims, as Rajagopalan and Lam et al disclose the same process, silicon nitride formation, using the same reactants, silane and nitrogen, and the use of optimum flowrates for the known reactants would be within the level of one of ordinary skill in the art. Where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the

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optimum or workable ranges by routine experimentation. See *Allen et al v. Coe*, 57 USPQ 136. Moreover, the discovery of an optimum variable in a known process is ordinarily within the skill in the art. See *In re Antonie*, 195 USPQ 6, (CCPA 1977); *In re Aller* 105 USPQ 233 (1955). In the present case the determination of the optimum flowrates for the reactants would be a matter of optimization for one of ordinary skill in the art, and therefore a *prima facie* case of obviousness is established

### ***Conclusion***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Alexander G. Ghyka whose telephone number is (571) 272-1669. The examiner can normally be reached on Monday through Friday during general business hours.

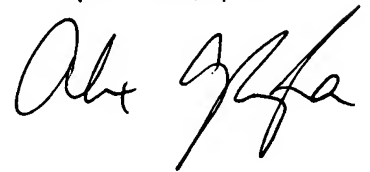
If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Michael Lebentritt can be reached on (571) 272-1873. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

AGG  
June 29, 2006

ALEXANDER GHYKA  
PRIMARY EXAMINER

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A handwritten signature in black ink, appearing to read 'Alex Ghyska', written over the printed name and unit number.